

# ***Connected Vehicle Pooled Fund Study – WisDOT Update***

**Todd Szymkowski, PE, PTOE, PMP**

Bureau of Traffic Operations

2024 SPRING CONNECTED VEHICLE POOLED FUND STUDY

MADISON, WISCONSIN

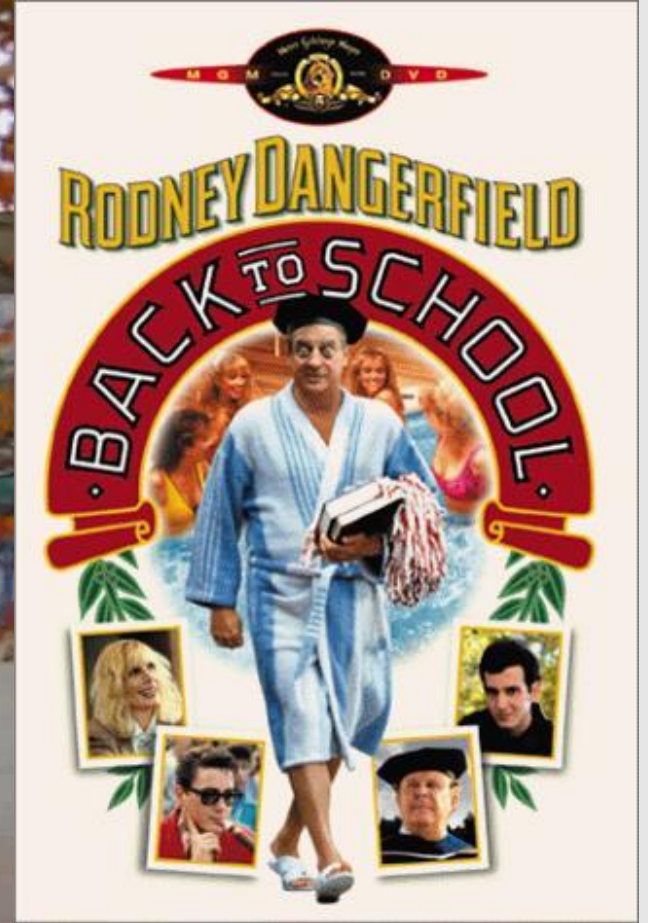
**April 30 – May 2**

# Agenda

- Organizing for CAV at WisDOT
- Regulatory Landscape
- Where are we going?
  - *WisDOT CAV Strategic Work Plan*
  - *Bureau of Traffic Operations (BTO) CAV Roadmap*
- What have we done?



# But first some additional Madison and Wisconsin Fun Facts







# TRUMAN EVERNIGHT

## Bush: 'Our Long National Nightmare Of Peace And Prosperity Is Finally Over'



WASHINGTON, DC—After days from winning the presidency and closing the door on eight years of Bill Clinton, president George W. Bush assured the nation in a televised address Tuesday that "our long national nightmare of peace and prosperity is finally over."  
"My fellow Americans," Bush said, "at long last, we have reached the end of the dark period in American history that will come to be known as the Clinton Era, eight long years characterized by unprecedented economic expansion, a sharp decline in crime, and sustained peace."  
—NYT page 1

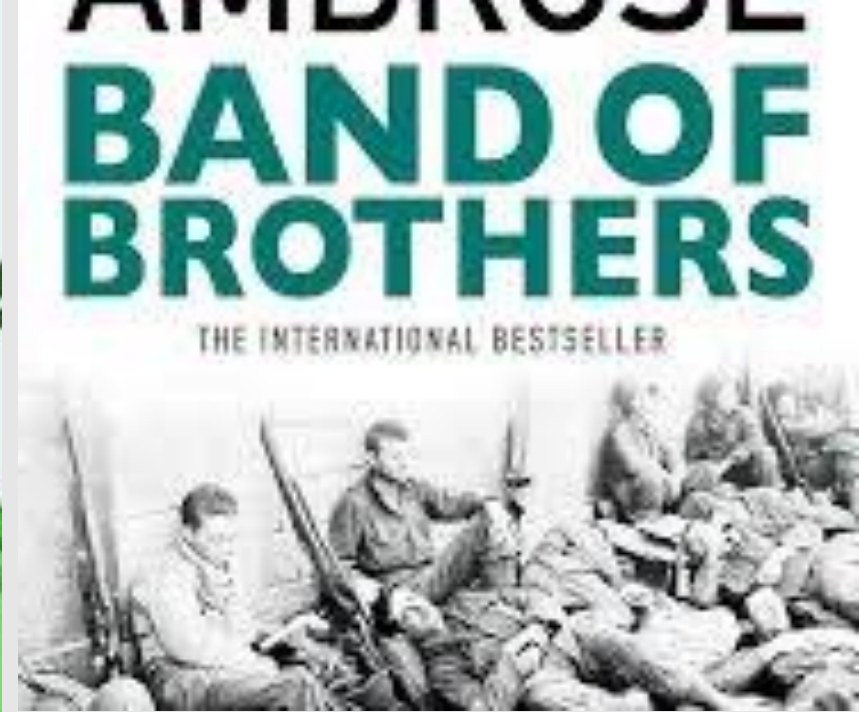
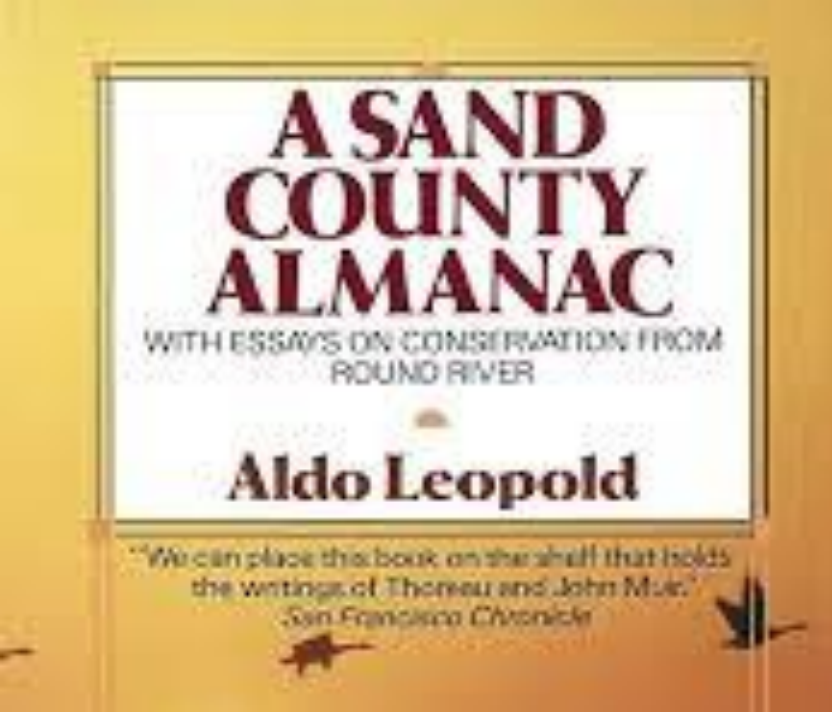
### Corpse-Reanimation Technology Still 10 Years Off, Say MIT Mad Scientists

CAMBRIDGE, MA—Dead tissue reanimation, proposed in the 1990s to be standard medical practice by 2005, won't be possible for at least another decade, scientists at the Massachusetts Institute of Technology's Wood Institute for Biomedical Research announced.

### Rural Nebraskan Not Sure He Could Handle Frantic Pace Of Omaha

SACRAMENTO, CA—A Nebraska farmer who moved to Omaha last year says he is not sure he could handle the frantic pace of the city.





# CAV at WisDOT

## External Engagement

- Wisconsin Automated Vehicle External (WAVE) Advisory Group
- Meets twice per year
- Led by DBSI

## WisDOT Enterprise-Wide

- CAV subcommittees
- Led by DBSI – Coordinates across 6 divisions
- Guiding Document: *WisDOT CAV Strategic Work Plan, 2024-2026*

## Bureau of Traffic Operations

- Supports pilots in coordination with TOPS
- National technical group engagement (e.g., CV PFS)
- Guiding Document: *WisDOT BTO CAV Roadmap*

- DBSI Leads and Coordinates Enterprise-wide CAV Initiatives
- BTO is a lead Technical and R&D Resource



# Wisconsin Automated Vehicle External (WAVE) Advisory Committee

## A forum of stakeholders:

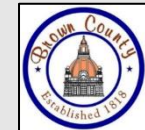
- State Legislature representatives
- State agencies
- Federal agencies
- Local government
- Academia
- Interest groups / stakeholders
- Industry

## Actions

- Provides input and advice to WisDOT on CAV planning priorities, implementation policies, and impacts to a safe and efficient transportation system

## WAVE Meeting Topics

- Local and Tribal Governments
- CAVs and Transportation Equity
- CAV Safety and Vulnerable Road Users (VRU)
- CAV Impacts on Law Enforcement and First Responders
- Cybersecurity of vehicles and infrastructure
- CAV Research in Wisconsin: Academia, Industry, Government

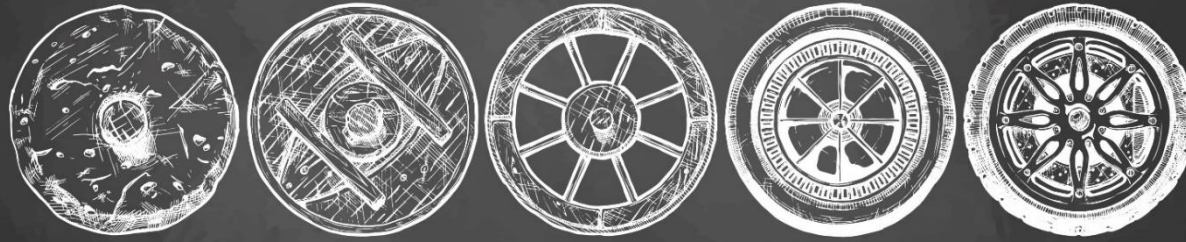


Complete roster on webpage [wisconsindot.gov/cav](https://wisconsindot.gov/cav)





# Automated Vehicles



## Current Legal Status of Automated, Autonomous, or Self-Driving Vehicles

Wisconsin state law currently requires an operator to be behind the wheel and in physical control of a vehicle at all times while driving on Wisconsin roadways.

As with any other vehicle that is operated on the roadway, the operator or owner is responsible for the appropriate and safe operation of the vehicle while driving it. This includes the use of any technology the vehicle is equipped with, any malfunctions of the vehicle, and adherence with [current state law](#) and the [Rules-of-the-Road](#).



# WisDOT CAV Strategic Work Plan 2024-2026



## *Objective areas of focus*

1. Statute, Policy and Regulation
2. Communications and Outreach
4. Organizational Alignment, Coordination, and Readiness
5. Develop Transportation System Infrastructure and Operations Readiness
6. Research, Testing, and Pilot Projects
7. Data Governance and Security
8. Law Enforcement and First Responder Services



# 1. Statutes, Policy, and Regulation



## Statutes

- Developing recommendations to update and clarify state statutes for autonomous vehicles

## Platooning

- 2017 Wisconsin Act 294 eliminated the required following distance for electronically controlled vehicles.
- How does platooning affect HAZMAT, school buses, liquid loads, logging, etc.?
- Provided guidance for truck platooning , included guidance for *Law Enforcement and pilot training and AV demo.*



# 2. Communications and Outreach

- **CAV Communications and Outreach Strategy** - published on the WisDOT website

## Audiences

Analysis of key audiences, their communication needs, and potential communications channels

## Messaging

High-level messaging for each of the major audience categories

- General public
- Local transportation officials
- State and Federal policy makers
- Law enforcement/first responders
- Industry and research partners

## Tactical Plan

Description of the tactical plan built from the message strategy.

- **CAV Attitudes and Perceptions** survey completed Feb 2024



# 3. Partnerships

– now incorporated into all projects

- Education is a priority
- The most valuable **partnership** to pursue at this stage would promote education, *communications and outreach*.
- How to do that?
  - Subcommittee is reviewing needs, strategies and models for a CAV education partnership.
  - **CAV Attitudes and Perceptions** survey and analysis will help guide the Communication and Outreach tactics.



# 4. Organizational Alignment, Coordination, and Readiness

## Objective and key Actions:

- Department scan of potential impacts on business operations, processes and affected partners or programs.

4 ▾ DBM DBSI DMV DSP DTIM DTSD EO + Search (Ctrl+E)

• Membership in external organizations

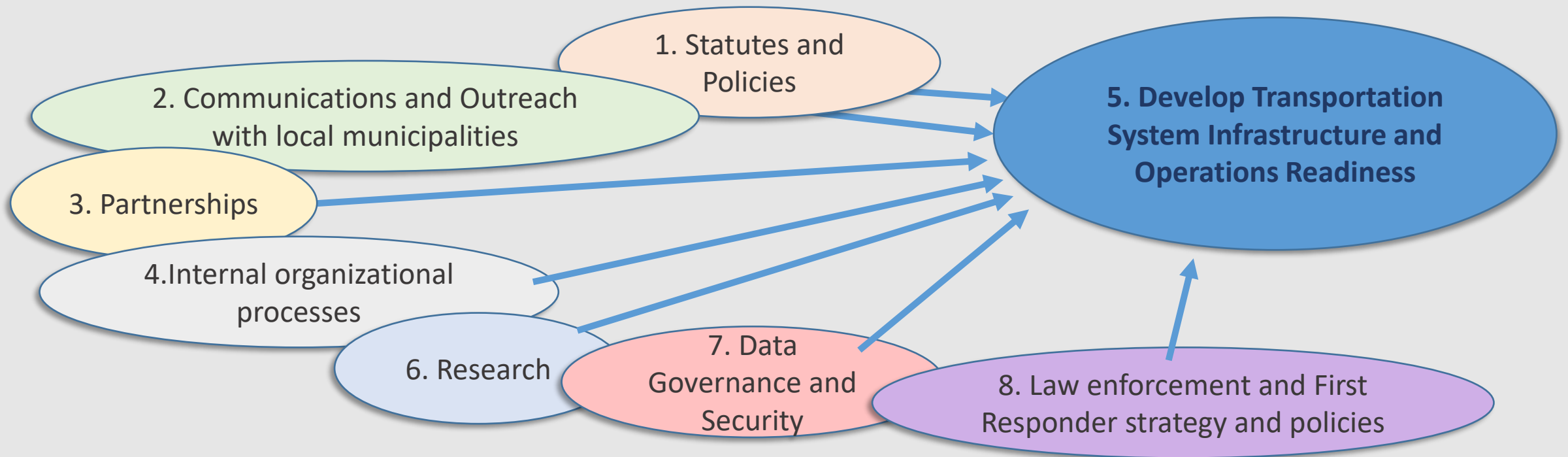
Process	Why Impacted	-CV -AV W/driver -AV W/o a driver	Upstream or downstream division or process affected	Constraining state or federal statutes	General Plans to Address	Timeline / Urgency 1 yr 2 yr 5+ yrs	Priority 1-10 1=highest	-Actionable -Emerging -Positioning	Potential Cost / new resources	Created by / edit by initials
Process for AV crash scene	Special CV or AV considerations may be needed. Contacting the remote owner, towing, enforcement, safety.	AV W/o a driver		WI Chapter 346	SOP development; Training	5+	10	Positional		BJB LM
Understanding vehicle feature tech for crash scene investigation	MMUCC - Capturing CV operating feature during crash.	AV w/driver and w/o driver	Need new data fields in MV4000, new safety analysis			1yr			New cabling, software.	BJB
Process for	If an alt route is established	AV W/o		WI	SOP	5+	10	Positional		LM

MLD



# 5. Develop Transportation System Infrastructure and Operations Readiness

- Implementation of projects, policies, operations, etc. will be guided by the results of the prerequisite work done by other committees



# 6. Research, Pilots and Testing

## Participating in CAV research initiatives

- **CV Pilot projects**
  - MMITSS\* Park St. corridor, UW-TOPS Lab and the City of Madison
  - Phase 3 integration with Hwy 12/18
- **Work Zone Data Exchange (WZDx) Phase I & II** – USDOT funded projects in 13 states
- Funding sources, grants and applications for IJJA/BIL, SMART, ATTAIN federal grants.
- Grant preparation: identifying potential projects and preparing grant applications ahead of funding windows





# 7. Data Governance and Cybersecurity

- IPIT, the UW Milwaukee **Institute for Physical Infrastructure and Transportation** has created a data governance framework, oversight and management structure for CV and AV data.

- Data Governance structure would manage data collection justification, privacy and security issues, storage, records retention, capital expenditures, total life cycle costs and planning, new data uses for operations or road design

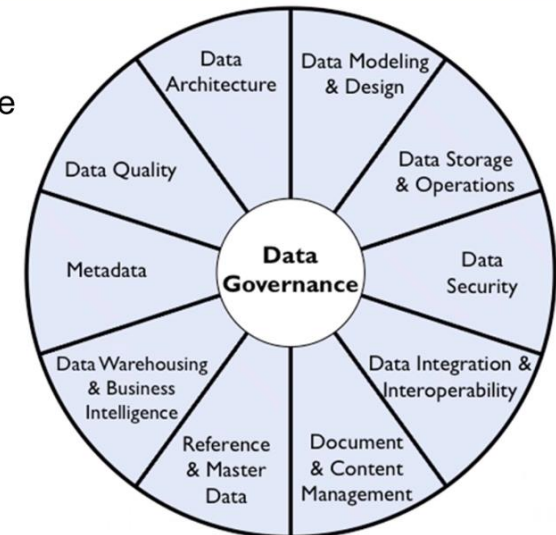
- **Cybersecurity in CAVs**

- Internet of Things connecting to WisDOT Traffic Management Center networks
- State Patrol squad car computers and personally identifiable information
- Connected vehicle data pipelines

## Steps for WisDOT Data Governance

- Identify best practices at other DOTs
- Socialize the concept of Data Governance
- Identify key stakeholders at WisDOT
- Draft Data Governance structure
- Draft Policies and Procedures

Questions and how to plug in



# 8. Law Enforcement and First Responder Services

- *Traffic Incident Management Enhancement (TIME)* member survey used to inform content for TIME training

1. Department of Justice law enforcement CAV training video created
2. TIME Law Enforcement First Responder training and AV demo with Racine Badger

- Interested Parties
  - State and local law enforcement
  - First Responders
  - State and Local Officials
  - Other interested parties
- Training package available on [wisconsindot.gov/cav](https://wisconsindot.gov/cav)



# WisDOT BTO CAV Roadmap

- Initial version 2019
- 2024 BTO Roadmap aligns with CAV Strategic Work Plan

2024

## WisDOT BTO Connected and Automated Vehicle Roadmap



April 2024



If you have any questions about this document, please contact the  
WisDOT BTO Traffic Systems Unit Supervisor

Version: April 2024



# BTO CAV Roadmap

## Strategic Direction

Introduction and History

Broader CAV Initiatives

Alignment with WisDOT Strategic Work Plan

5+ Year Time Horizon

## Program Development

Completed

Ongoing (no end date)

- National
- Regional
- Internal

Active (end date)

Actionable

Emerging

Positioning

## Projects, Services, & Activities

Definition

Benefits

Details

Statewide Objectives Supported

Lead/Support/Partners

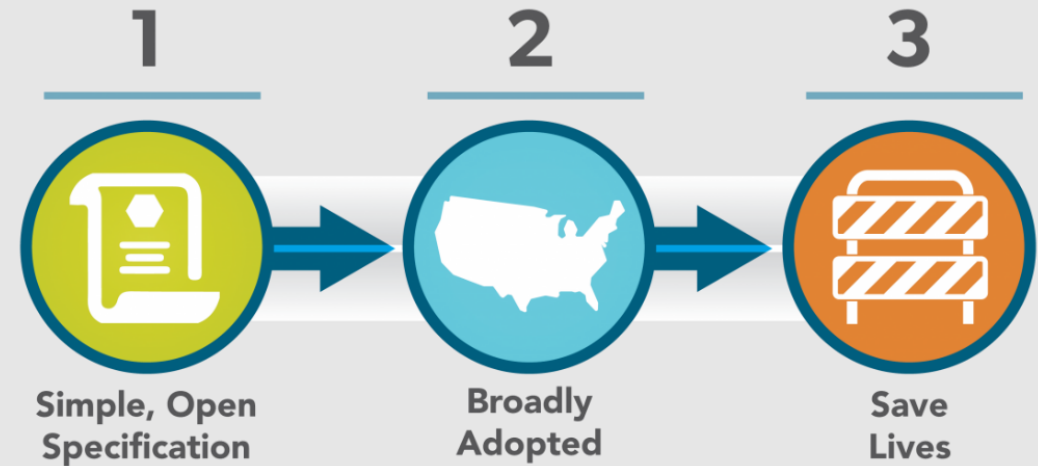
Timeframe

Preliminary Resources



# Completed Examples

- AASHTO SPaT Challenge
- **Work Zone Data Exchange Feed**
- **Connected Arrow Board Pilot**
- Phases 1 and 2 of CV Tech Testing
- Supported Development of CAV Training Materials for Emergency Responders





# On-going Examples

## NATIONAL & REGIONAL

- **Pooled Fund Studies**
  - CV
  - Enterprise
  - TMC
  - Smart Work Zones
- AASHTO CTSO
- ITS America Subcommittees
- PAVE Public Sector Advisory Council
- MAASTO CAV Committee
- ITE CAV Steering Committee

## INTERNAL

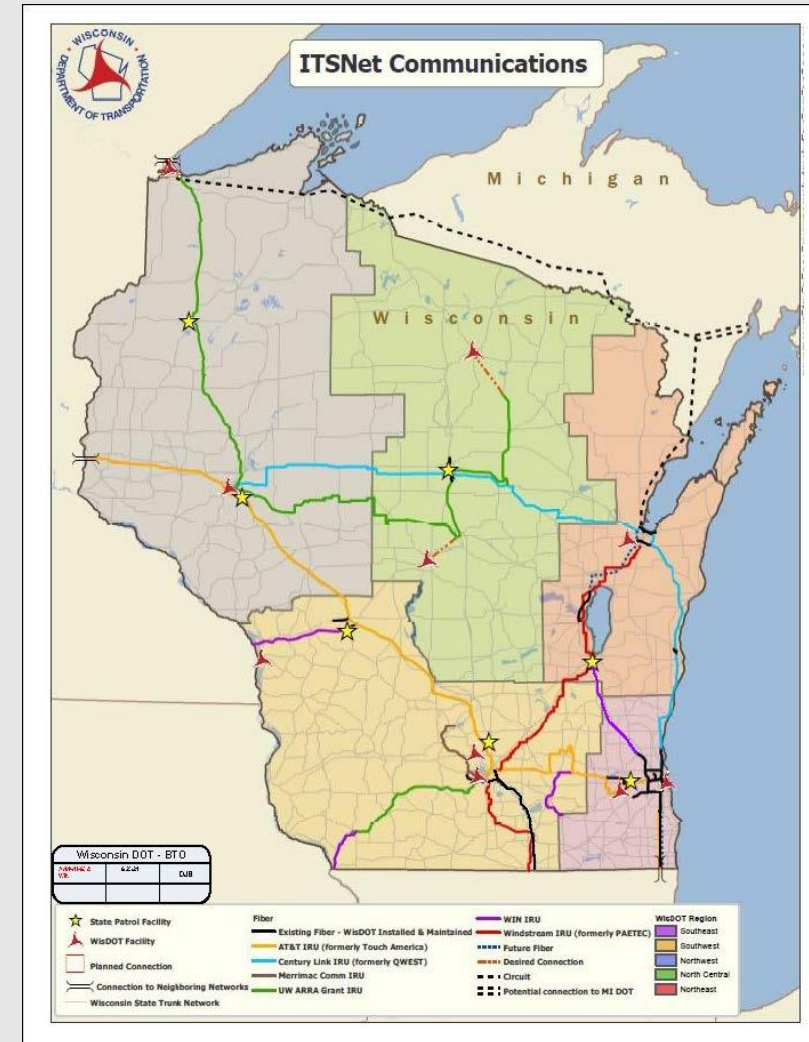
- **CAV Subcommittee Leadership**
- **SISP for limited pilot funding**



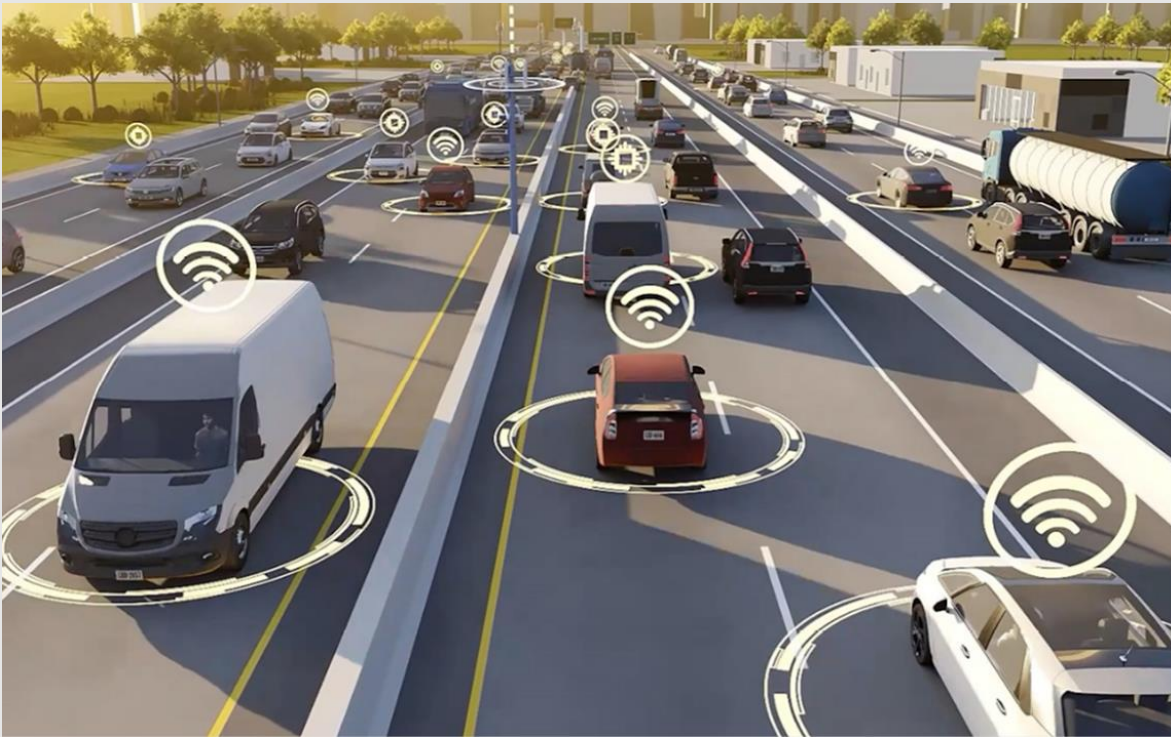


# Active Examples

- Portfolio of CV Project Concepts
- Update Statewide ITS Architecture
- **ITSNet Strategic Plan**
- Continued CV Testing and Piloting
- WZDx for Connected Field Devices
- Keeping TIM Community up to date
- Piloting of Connected Work Zone Devices on Local Roads
- Piloting Autonomous Truck Mounted Attenuator

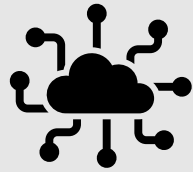


# Actionable Examples



- Portfolio for CV Safety Applications
- Industry Partnerships to open Wisconsin for broader CAV Testing and Development
- Pilot CV Data to support business needs across WisDOT





# Emerging Examples

- Assess Impacts to TMC Control Room
- Update Signal and ITS Standards and Policies
- **CV Data Governance and Cybersecurity**
- Impacts on traffic/capacity/safety analysis
- **Pilot CAV Readiness Assessments for existing roads**



# Readiness Assessment

## OVERVIEW OF READINESS LEVELS

### Physical

ITS Infrastructure  
LEVEL 02

Traffic Control  
LEVEL 02

Roadway  
LEVEL 03

### Digital

Connectivity  
LEVEL 02

Data Management  
LEVEL 02

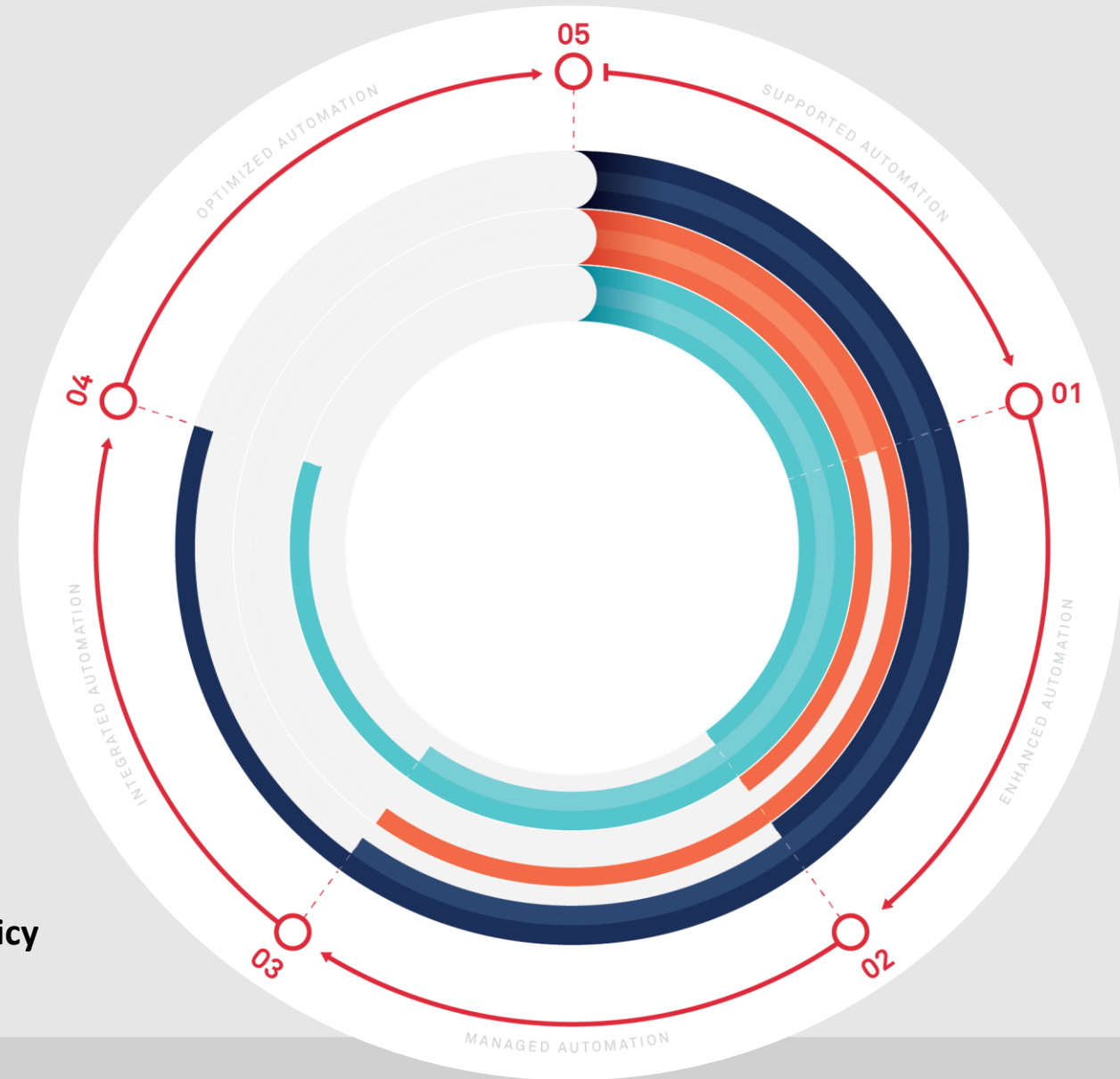
Cybersecurity  
LEVEL 04

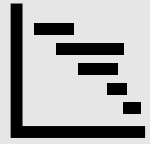
### Operations

Active Management  
LEVEL 02

Mobility Integration  
LEVEL 02

Governance and Policy  
LEVEL 03





# Projects, Services, and Activities

- Strategy
- Priority
- Benefits
- Details
- Lead/Support
- Partners

- Timeframe
- Status
- Resources
- Related Strategies

**02**

**BTO STRATEGY**  
Publish Work Zone Data Exchange (WZDx) Feed and Pilot Connected Arrow Boards

**WISDOT CAV STRATEGIC WORK PLAN OBJECTIVE(S)**  
RESEARCH, TESTING, AND PILOT PROJECTS  
DEVELOP TRANSPORTATION SYSTEM INFRASTRUCTURE AND OPERATIONS READINESS

**BENEFITS**  
WisDOT will be putting work zones on the map and will eventually be able to provide real-time work zone information to the traveling public.

**DETAILS**  
The WZDx Demonstration project proposed in this grant application will build on existing investments to publish a new WZDx-compliant data feed in Wisconsin.

While the primary goal over the performance period is to establish a new, statewide WZDx-compliant data feed, the architectural approach will provide additional benefits for Wisconsin work zone data management. The project will also demonstrate a process flow to transform estimated to verified lane closure information in the WZDx using real-time information from connected devices.

The WZDx project is intended to enhance the overall lifecycle of work zone data management in Wisconsin. This includes improved interoperability of existing work zone data management systems based on the work zone data dictionary standardized data elements and services and the future development of a work zone event data warehouse to support performance management, planning, and research. Leveraging the ATMS as the primary fusion engine for planned and verified work zone event data will also lay the groundwork to incorporate new and emerging sources for work zone event data including connected and automated vehicles (CAV) and cloudbased data sources.

**LEAD UNIT**  
DTSD BTO Traffic Design Unit

**SUPPORTING UNIT(S)**  
BTO TMU

**PARTNER(S)**  
Arcadis, TOPS lab, Waukesha & Columbia County

**TIMEFRAME**  
Completed  
September 2021 - March 2023

**STATUS**  
Completed - Feed published in March 2023

**RESOURCES**  
\$250K in federal and state funding. Arcadis and TOPS lab as contractors

**RELATED BTO STRATEGIES**  
● Implementation of WZDx Connected Devices in the Field

Version: April 2024

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**BTO STRATEGY**  
Implementation of Work Zone Connected Devices in the Field

**WISDOT CAV STRATEGIC WORK PLAN OBJECTIVE(S)**  
RESEARCH, TESTING, AND PILOT PROJECTS  
DEVELOP TRANSPORTATION SYSTEM INFRASTRUCTURE AND OPERATIONS READINESS

**BENEFITS**  
Provide verified, real-time, traveler information about work zones to make them safer for workers and the traveling public.

**DETAILS**  
There are a number of projects that will be completed to reach the ultimate goal of providing verified lane closure and other work zone information with connected work zone devices.

The initial project continued the efforts with the Work Zone Data Exchange (WZDx) grant that WisDOT was awarded in FY22 to publish a WZDx compliant feed and demonstrate going from planned to verified lane closures. This project will develop a concept of operations for gathering information from connected devices in the field as well as go from a planned lane closure to a verified lane closure through the connected device.

Another part of the project will develop a connected work zone manager, develop linkage between connected devices in the field and make enhancements to the Advanced Traffic Management System to better support Smart Work Zones and connected devices.

The last piece of the project will be implementation of connected devices in all work zones.

**LEAD UNIT**  
DTSD BTO Traffic Design Unit

**SUPPORTING UNIT(S)**  
BTO TMU

**PARTNER(S)**  
Arcadis

**TIMEFRAME**  
Active  
October 2022 - June 2025

**STATUS**  
Design

**RESOURCES**  
\$370K in state funding  
Arcadis as contractor

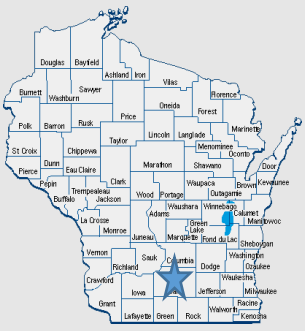
**RELATED BTO STRATEGIES**  
● Publish Work Zone Data Exchange Feed and Pilot Connected Arrow Boards

Version: April 2024



# What have we done so far?



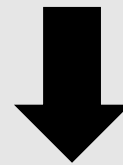


# Park Street & Beltline Connected Corridor

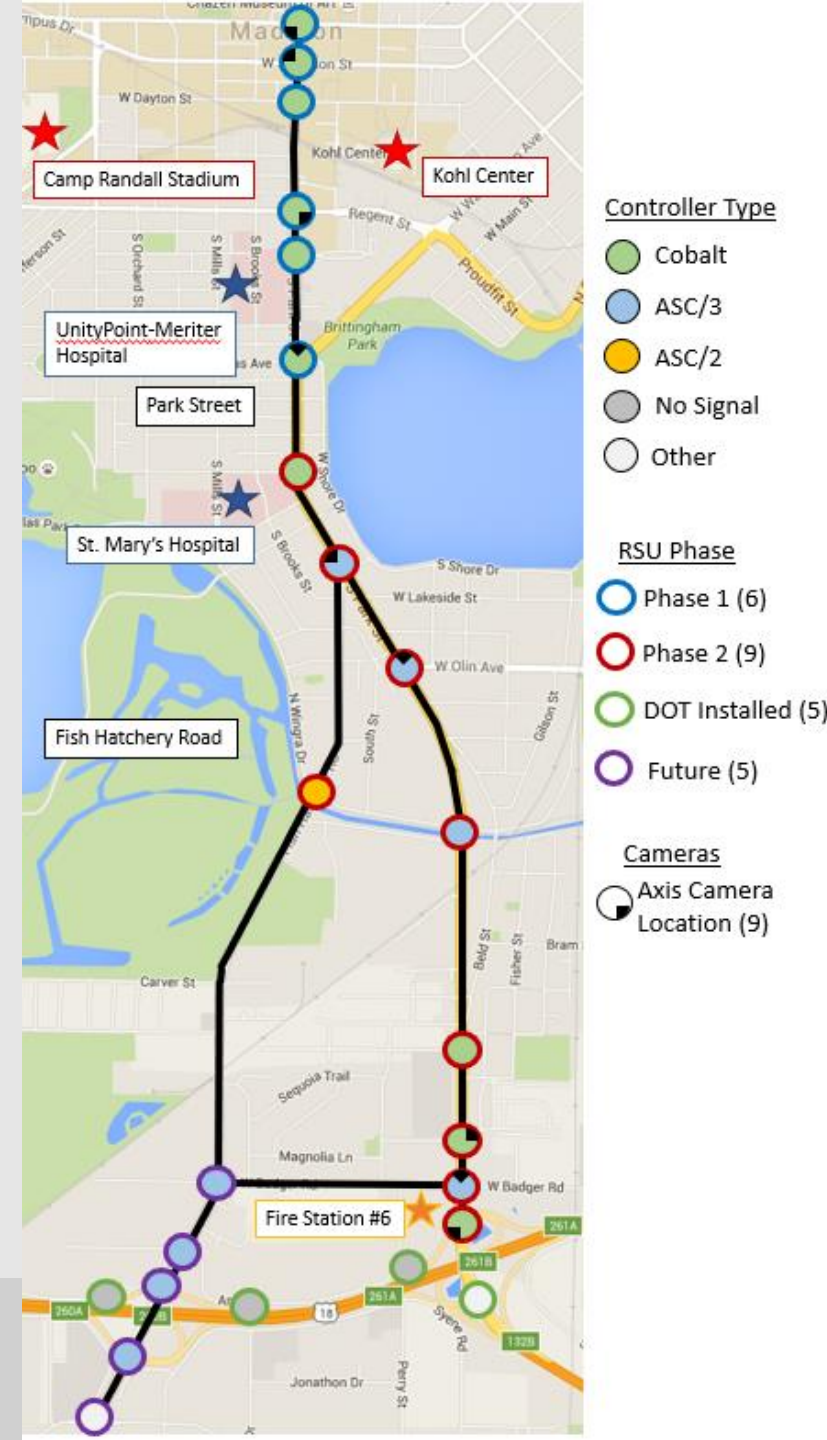
- Satisfied SPaT (Signal Phasing and Timing) Challenge
- Full Build = 27 DSRC/C-V2X RSUs Planned / Simulated Apps
  - Transit Signal Priority
  - Transit/VRU interaction
  - Red light violation warning
  - Pedestrian / bike crossing
  - V2I general testing
  - Digital Twin



SPaT, MAP

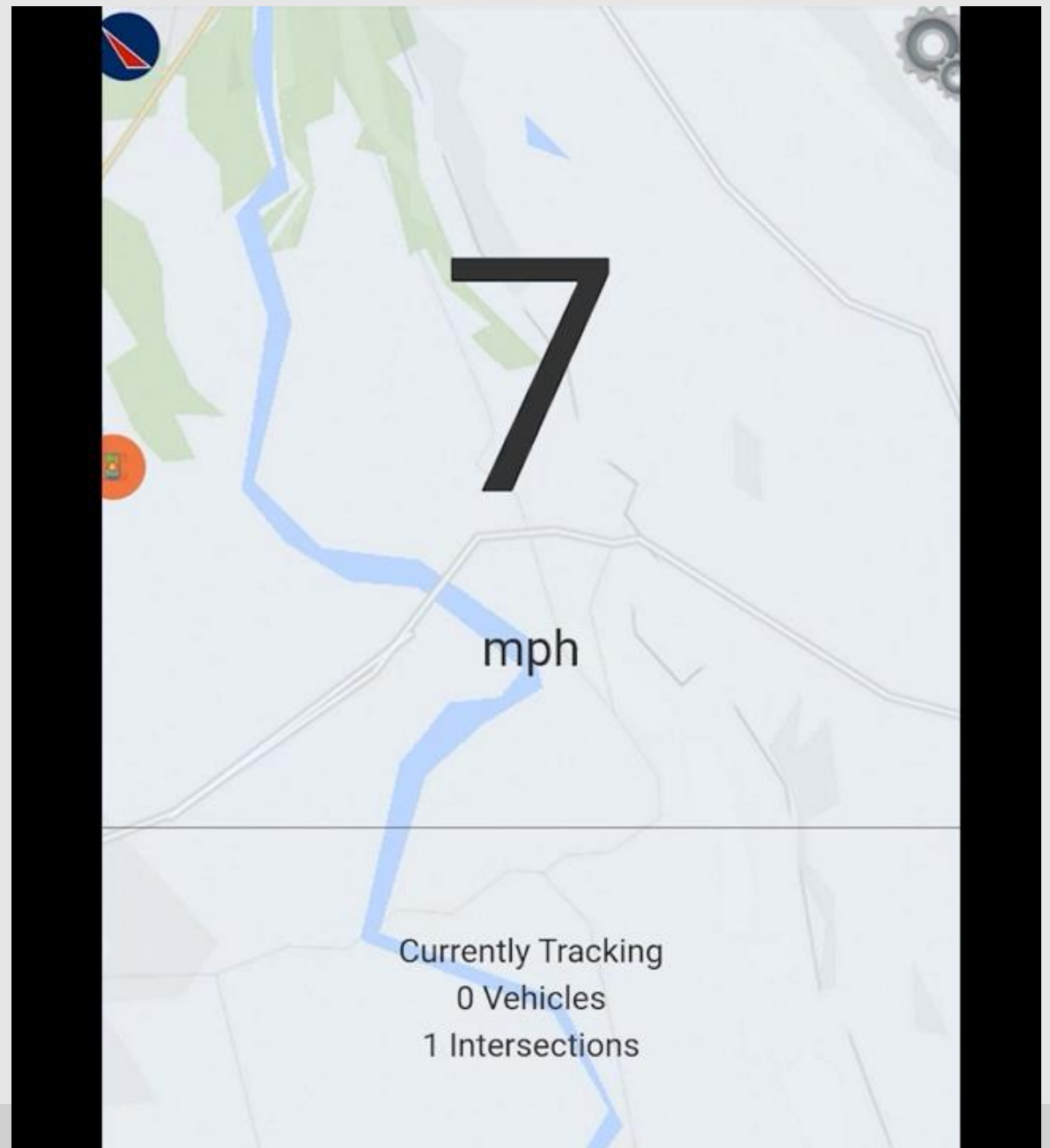


BSM

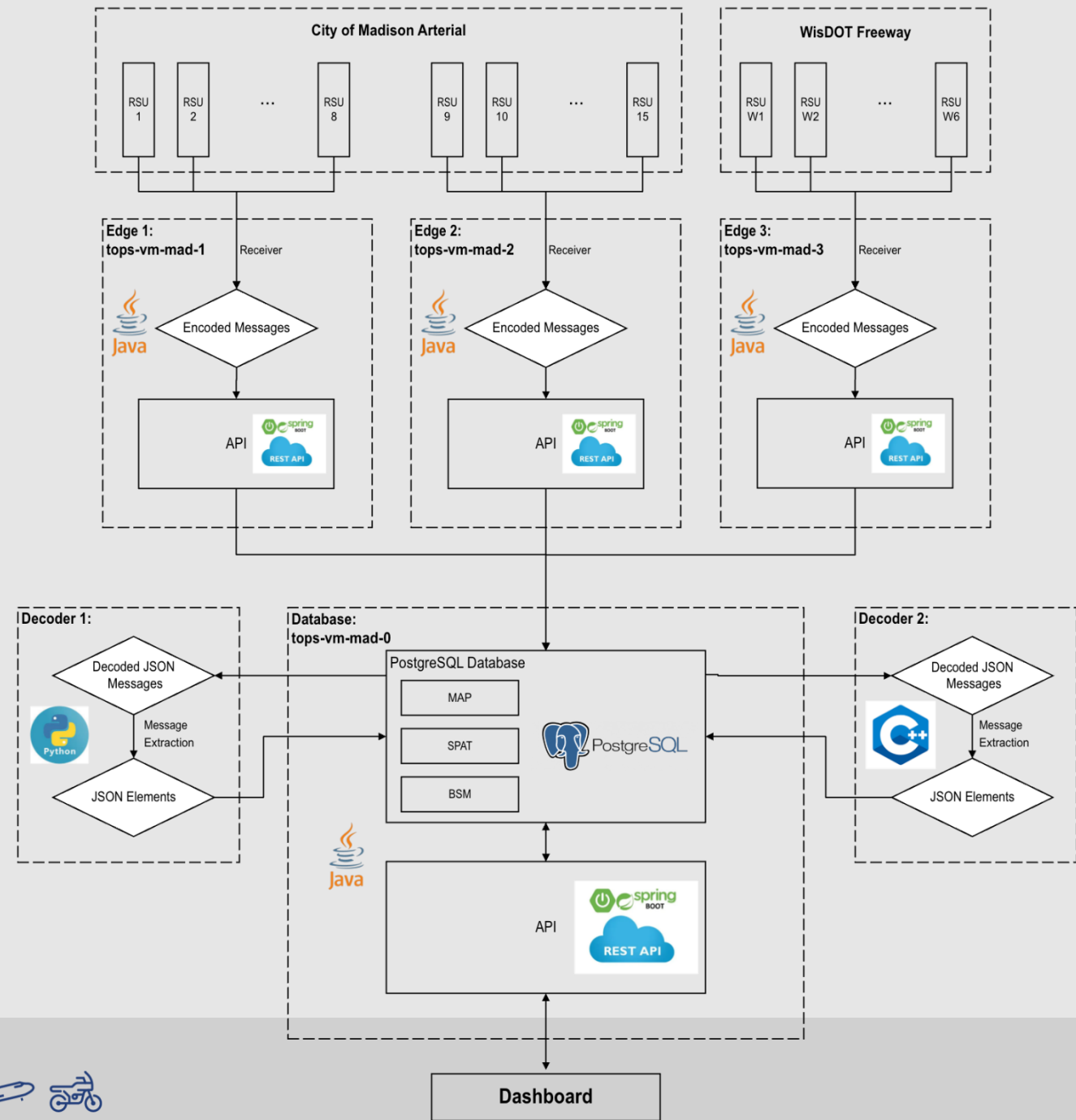




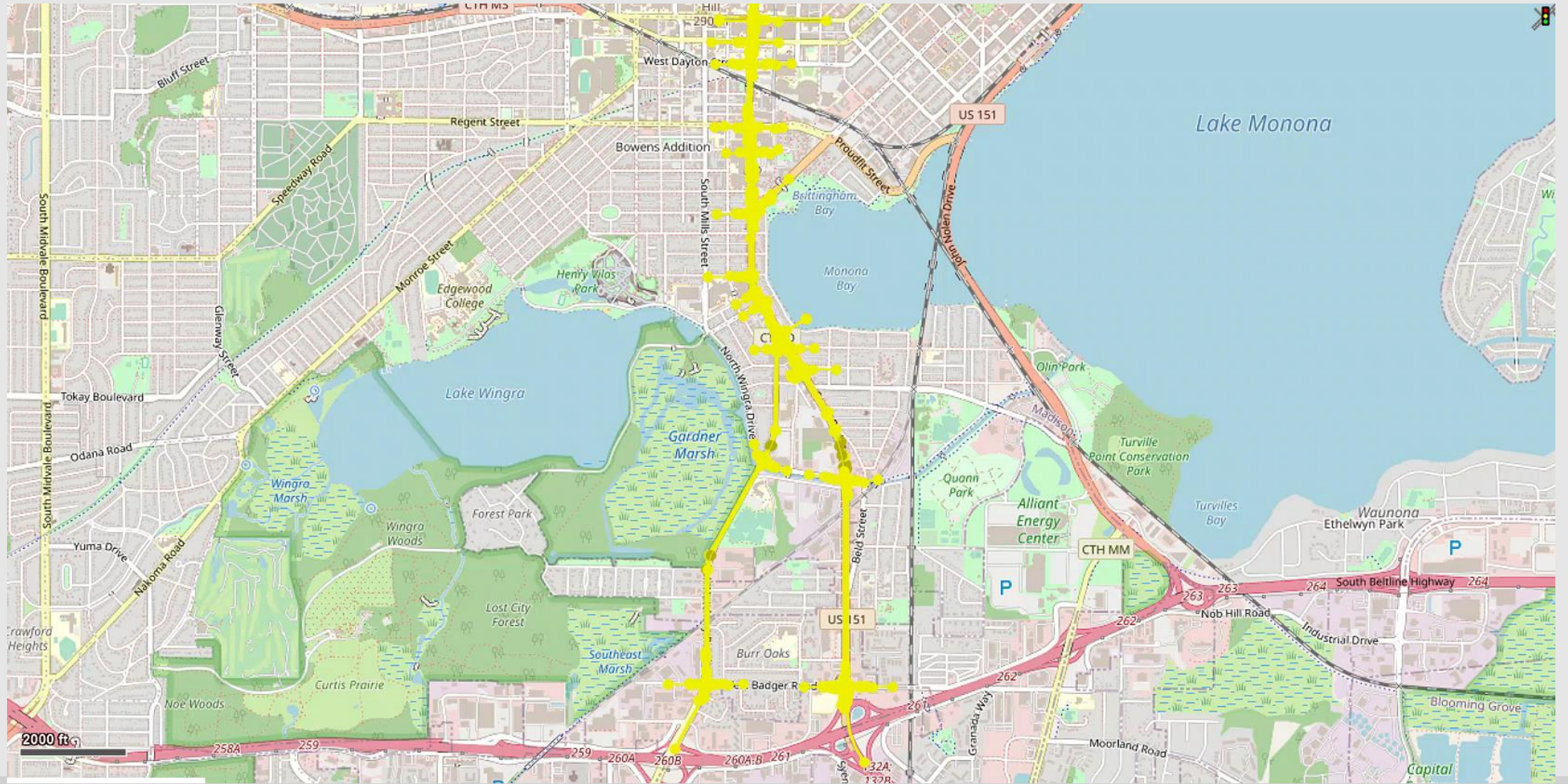
SPaT, MAP, BSM



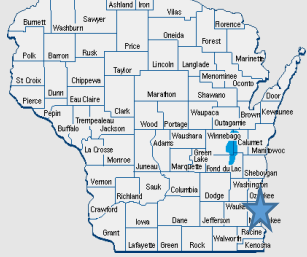
# Connected Corridor - Data Pipeline



# Connected Corridor Microsimulation Model







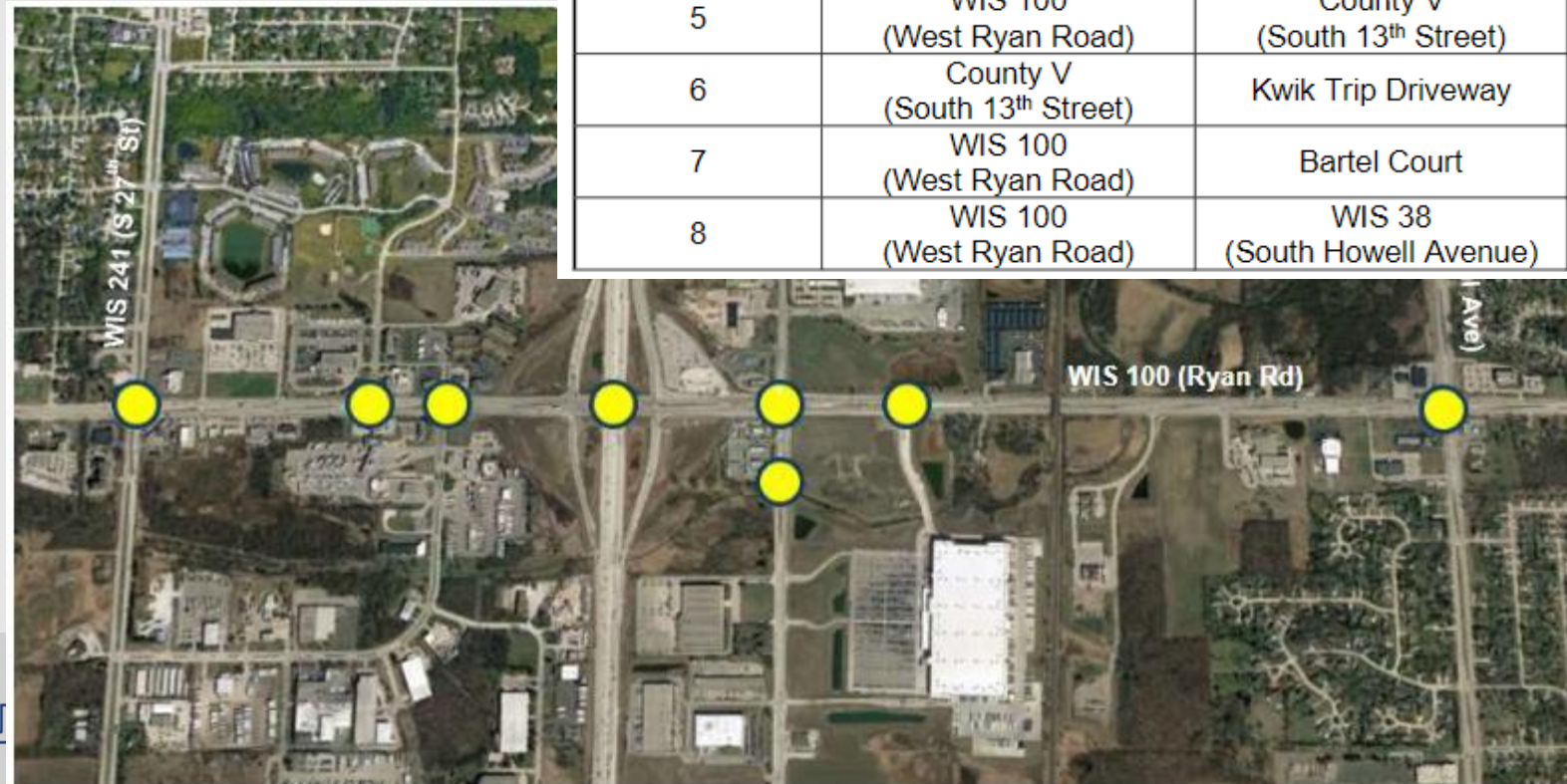
# WisDOT CV Pilot Phase 1 & 2

Phase 1 – Bench Testing with 1 DSRC RSU

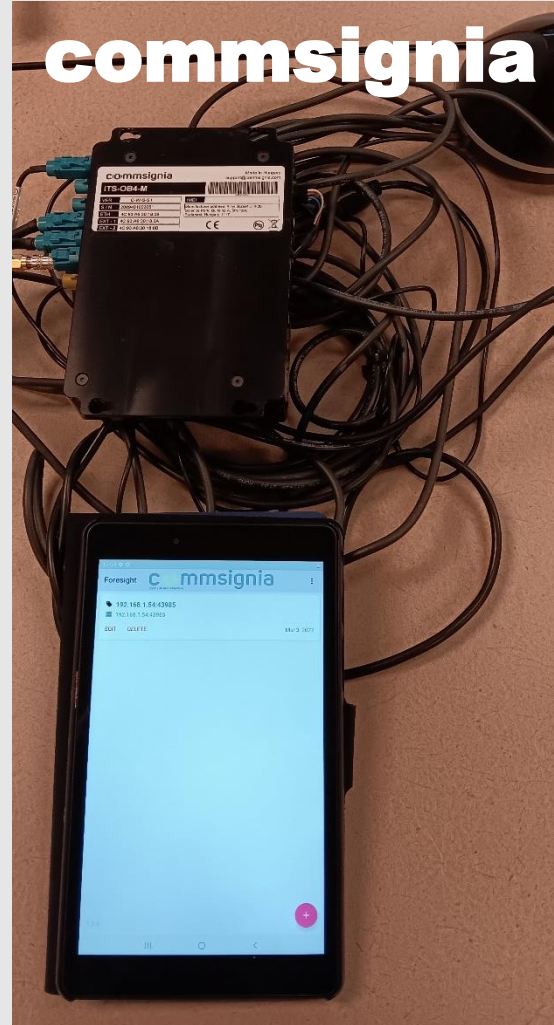
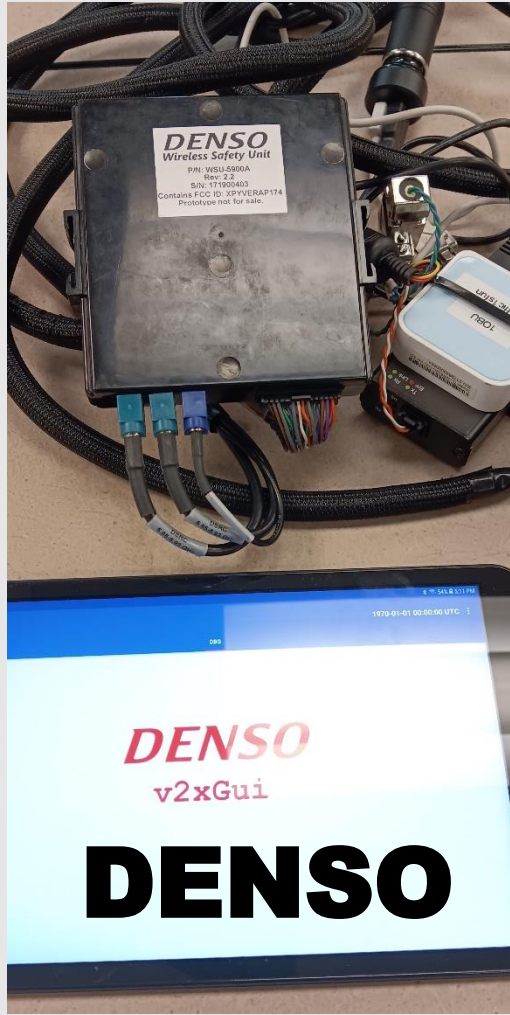
Phase 2 – 8 Intersection Testing

- Dual-mode
- Message testing
  - SPaT
  - MAP
  - BSM
- Range testing

Intersection No.	Primary Roadway	Cross Street
1	WIS 100 (West Ryan Road)	WIS 241 (South 27 <sup>th</sup> Street)
2	WIS 100 (West Ryan Road)	South 22 <sup>nd</sup> Street
3	WIS 100 (West Ryan Road)	South 20 <sup>th</sup> Street
4	WIS 100 (West Ryan Road)	I-94 Interchange
5	WIS 100 (West Ryan Road)	County V (South 13 <sup>th</sup> Street)
6	County V (South 13 <sup>th</sup> Street)	Kwik Trip Driveway
7	WIS 100 (West Ryan Road)	Bartel Court
8	WIS 100 (West Ryan Road)	WIS 38 (South Howell Avenue)



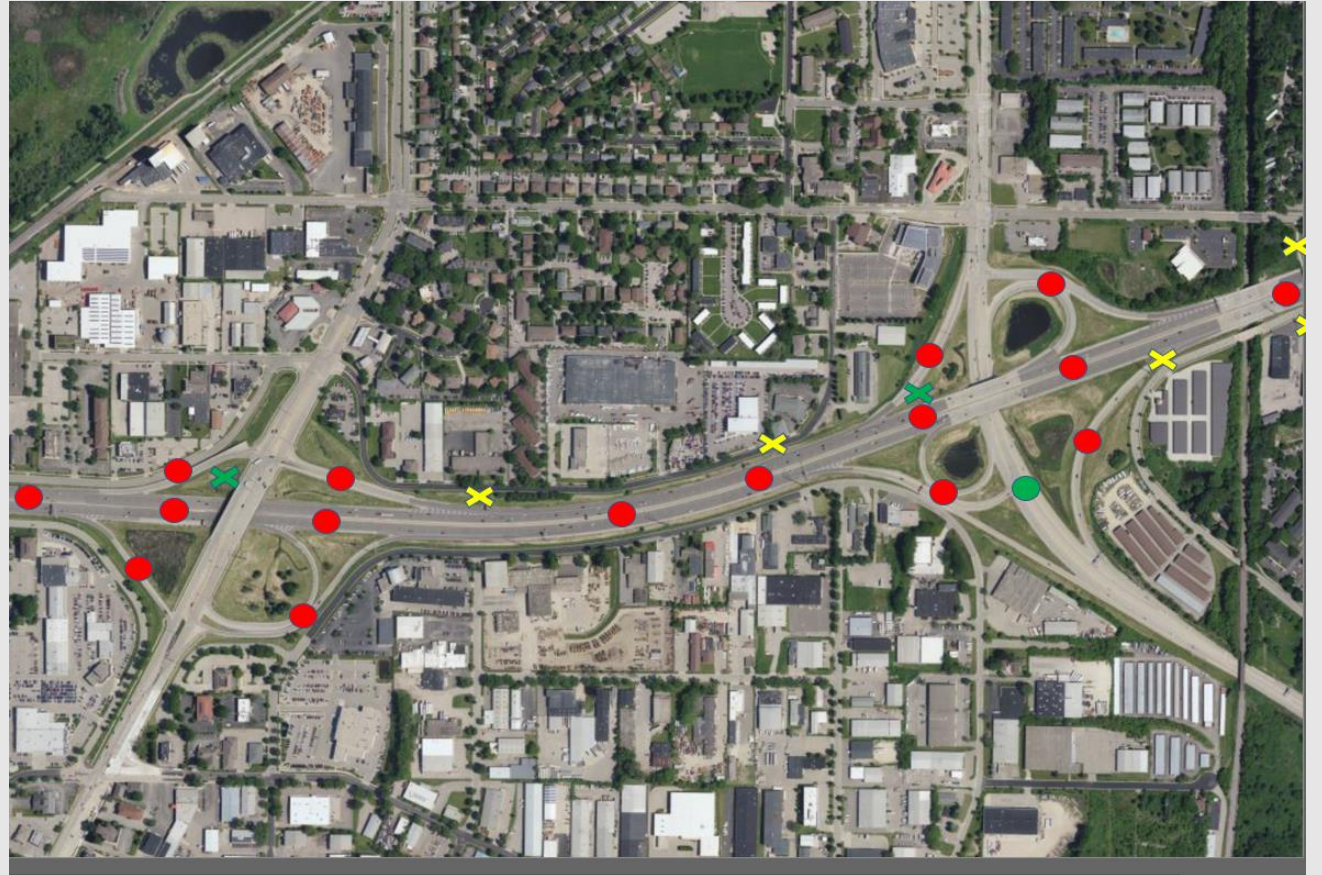
# WisDOT CV Pilot Phase 1 & 2



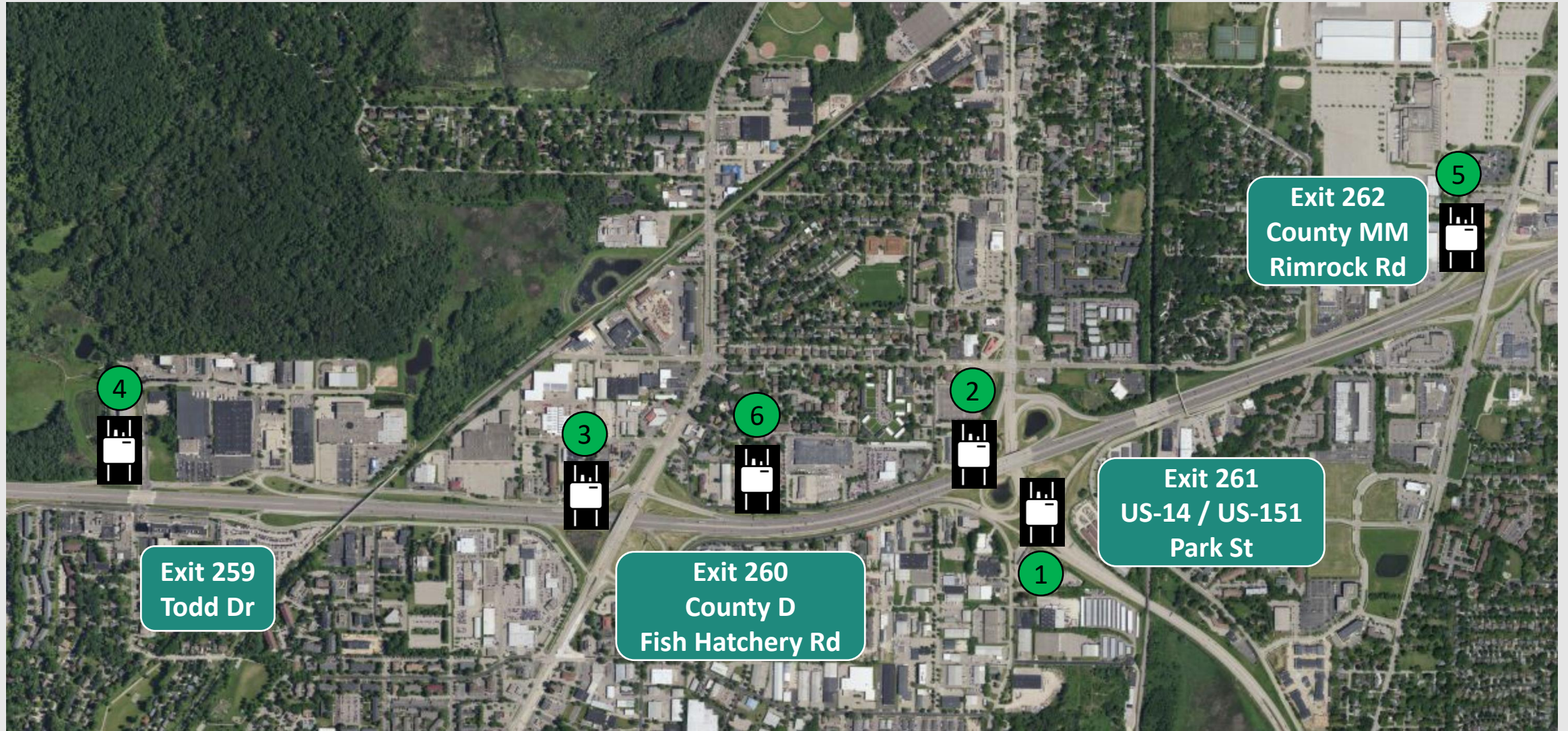
# WisDOT CV Pilot Phase 3

## RSU Design and Install Tasks

1. Determine locations for 6 RSUs
2. Installation planning
3. Field integration
4. Network integration



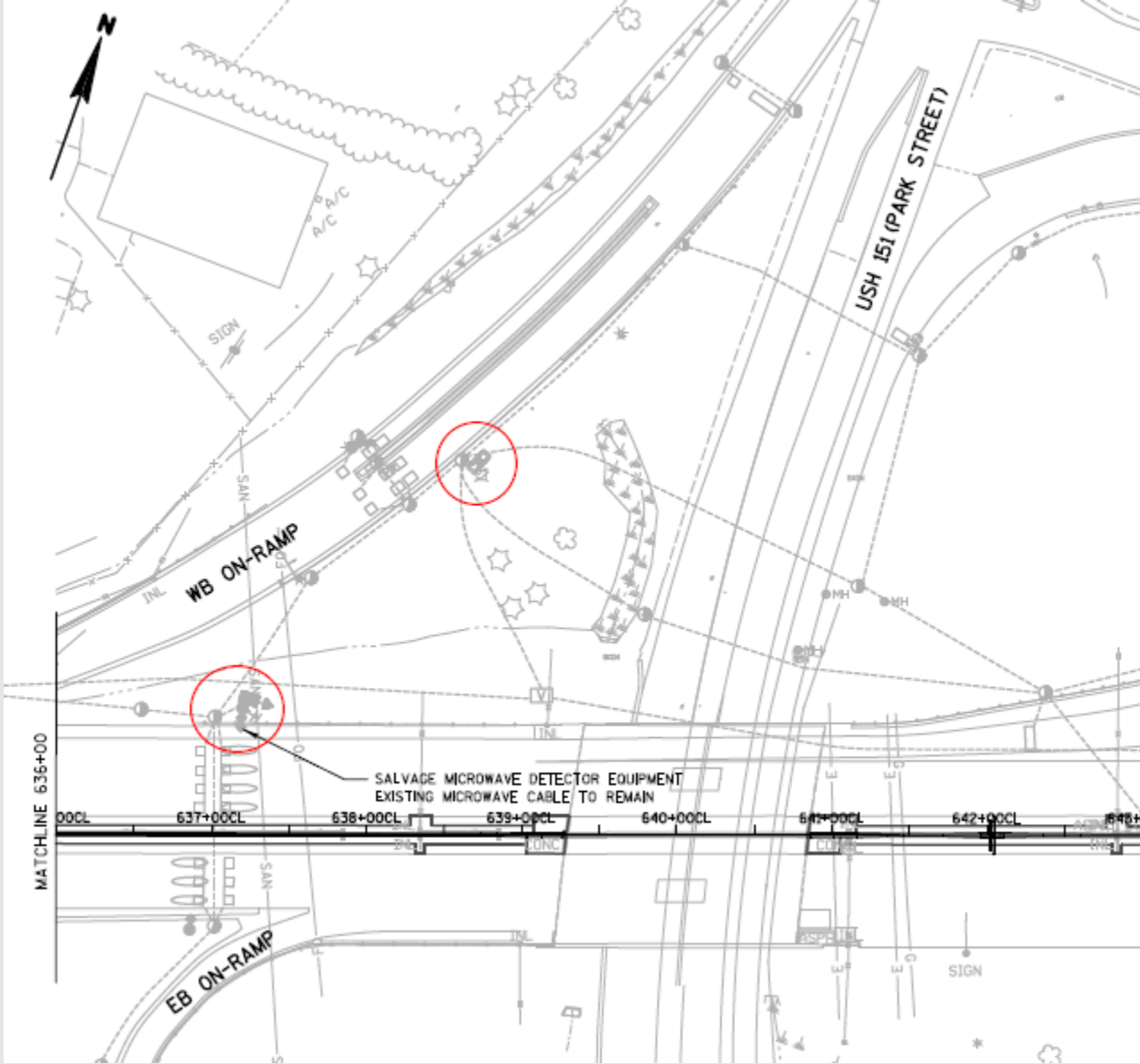
# Madison Beltline RSU Locations



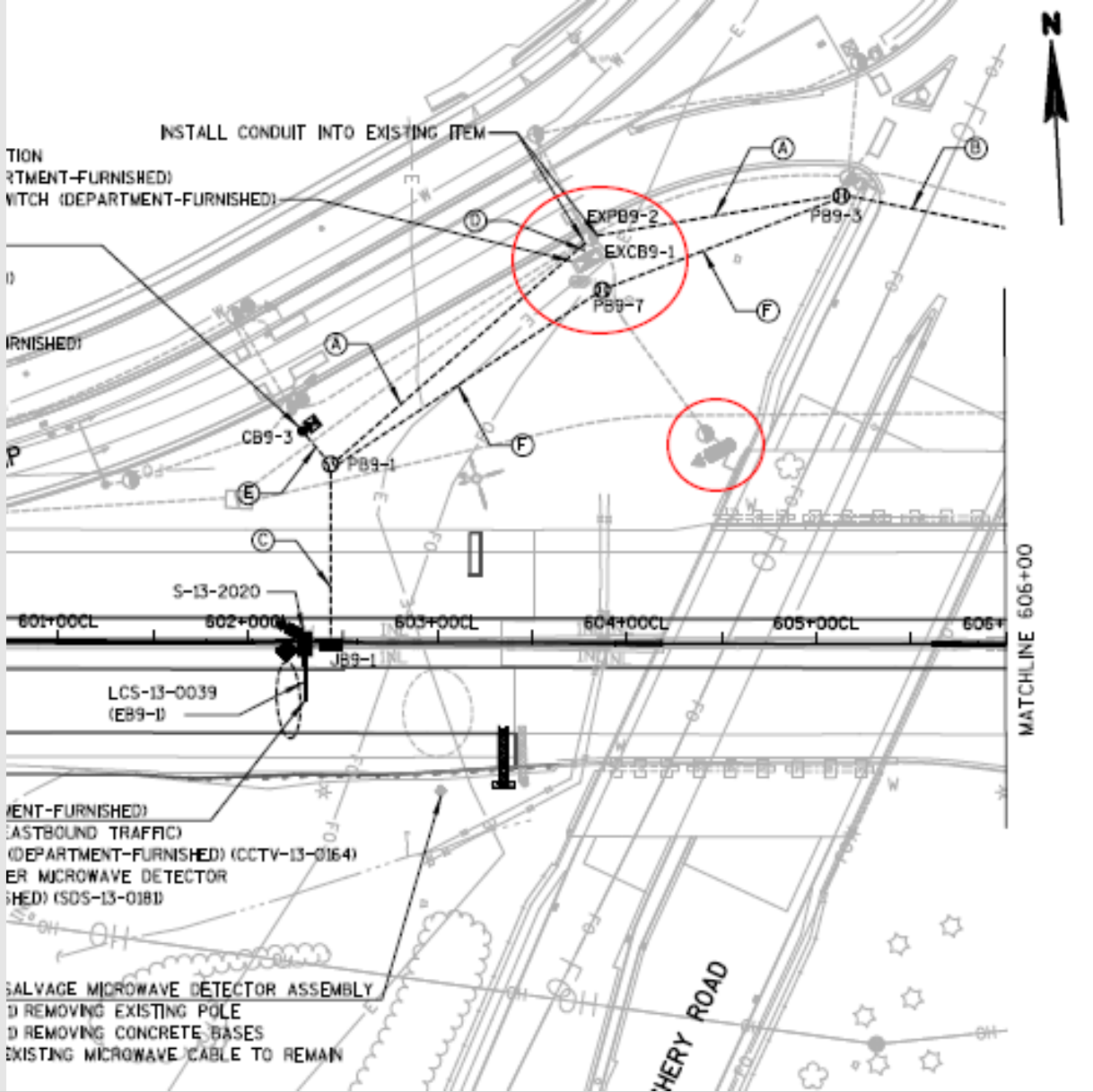
# RSU 1: Park St Interchange, South Signal



# RSU 2: Park St Interchange, NW Quadrant



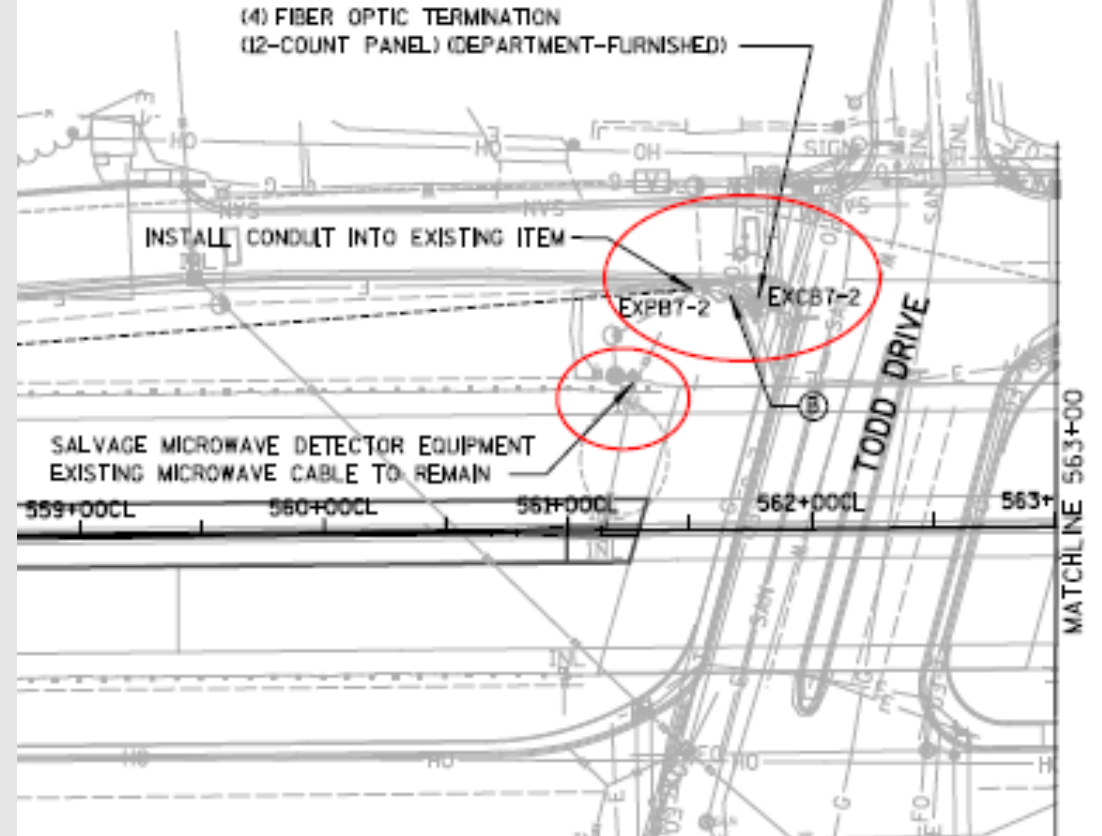
# RSU 3: Fish Hatchery Rd Interchange, NW Quadrant



# RSU 4: Todd Drive Interchange, NW Quadrant

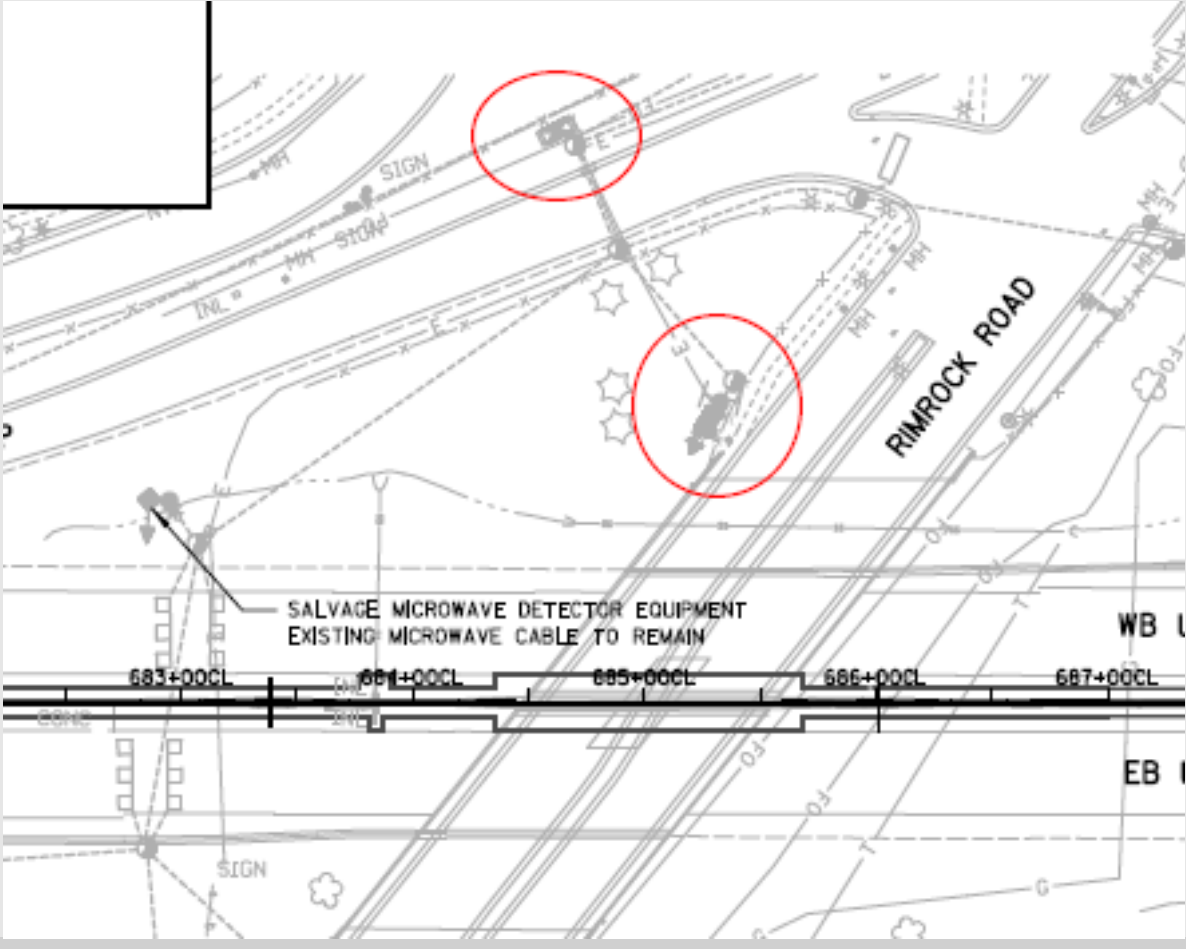


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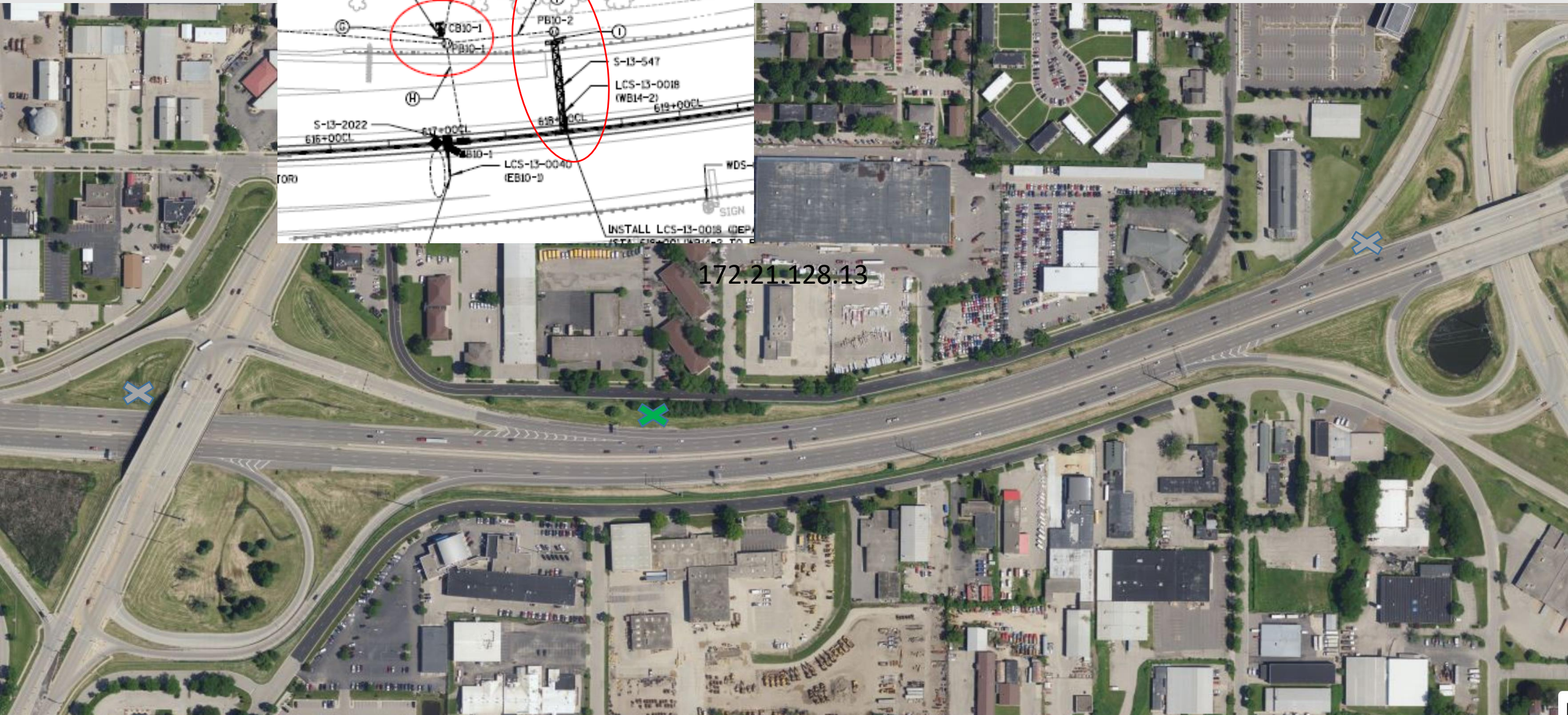
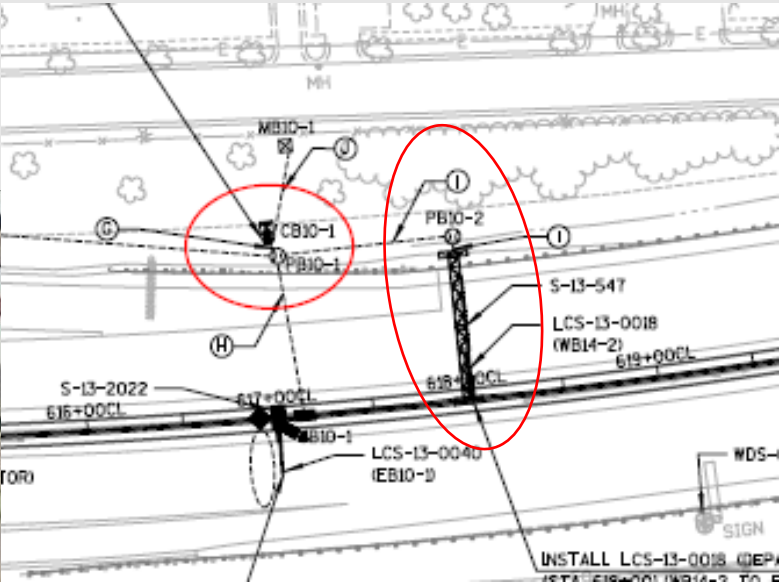




# RSU 5: Rimrock Rd Interchange, NW Quadrant



# RSU 6: Between Park and Fish Hatchery Interchanges, North Side



# WisDOT CV Pilot Phase 3

## RSU Testing

1. Traveler Information Messages
  1. Curve Warning
  2. Ramp Meter
  3. Direction/orientation
2. Future work
  1. Prepared for Flex Lane maintenance dashboard
  2. Comparison of data processing methods
  3. Ryan Road Integration
  4. Documentation



# Contacts

**Todd Szymkowski, PE, PTOE, PMP** Statewide Traffic Systems Engineer  
[todd.szymkowski@dot.wi.gov](mailto:todd.szymkowski@dot.wi.gov) (414) 227-3125

**Brad Basten** Strategic Initiatives Officer  
[brad.basten@dot.wi.gov](mailto:brad.basten@dot.wi.gov) 608-266-0786

[wisconsindot.gov/cav](http://wisconsindot.gov/cav)

